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Cover

Washington, the Bicentennial City, is shown in a high-altitude photograph taken from an aircraft for the Earth Observations Division of the Johnson Space Center. The plane was flying at an altitude of 50,500 feet. All the major buildings and thoroughfares in the nation's capital are visible.

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Monthly NASA Highlights

Weather Satellites

It has been 15 years since NASA launched its first weather satellite. Since that time, weather satellites have evolved into operational systems providing continuous day and night coverage of the world's weather patterns. The first satellite picture received on Earth showed the Gulf of St. Lawrence region, off Nova Scotia. With the development of more sophisticated instruments, the present weather system provides data used to monitor temperature, record rainfall and map soil moisture and ice features while providing worldwide weather coverage. Not a single major hurricane or storm system goes undetected or untracked.

The first weather satellite, the TIROS-1 (Television Infrared Observation Satellite), was launched by a Thor-Able rocket from Cape Canaveral, FL, on April 1, 1960. Since then, 30 experimental and operational weather satellites have been launched to test additional instrumentation or to use newly developed and proven techniques for more accurate forecasting.

With the evolution into operational weather systems, a new era began in worldwide weather coverage. Future experimental and operational satellites will endeavor to improve the accuracy of weather forecasting as well as increase man's knowledge of the Earth's environment.

Skylab Earth Resources Data Catalog

A catalog of the photographs taken in 1973-74 by the three Skylab crews using the Earth Resources Experiment Package (EREP) equipment was prepared under the direction of the Johnson Space Center. The data catalog is illustrated with color and black and white photographs. Six world maps identify the areas of the Earth photographed by Skylab's EREP instruments.

The 35,000 photographs taken during the Skylab missions are indexed to assist users in finding space photographs. The index lists by geographic coordinates every EREP photo giving the date and time of day taken, instruments used and geographical location (nation, ocean, state, city) and notes cloud conditions. The Skylab Earth resources equipment and data formats are described, along with an explanation of remote sensing techniques. Five chapters discuss in detail how the photographs may be useful in Earth resources related disciplines.

The 359-page catalog titled "Skylab Earth Resources Data Catalog" can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, at $12.50 per copy.

New Wing for Light Aircraft Being Tested

The Langley Research Center has begun flight testing a light, twin-engine research airplane called the Advanced Technology Light Twin (ATLIT). The test aircraft, a Piper PA-34 Seneca, was modified with a new airfoil shape built into the plane's wing, was fitted with spoilers rather than conventional ailerons, and was equipped with advanced aerodynamic devices developed to improve flight characteristics. The flight tests of the new generation plane will demonstrate technology for improved safety through better climb capability, improved operating economy through reduced fuel consumption, and improved utility with greater payload resulting from the lighter wing.

The ATLIT carries a crew of two, along with test equipment to record approximately 40 test measurements per flight during the scheduled 100 airborne hours in the flight test program. Test flights are being flown at Langley and for repeated take offs and landings at the relatively isolated airport at the Wallops Flight Center.

The new research plane is the product of a three-year effort by several industrial and university participants, directed by Langley engineers.

OAO-3 Experiment to Measure Chlorine Content in Atmosphere

Using the OAO-3 (Copernicus) spacecraft, the amount of ultraviolet light absorbed by a bright star will be measured when it is high in the sky and again as it sinks below the horizon. The readings will show the amount of atomic chlorine naturally present in the star's spectrum as compared with the amount measured when the Earth's atmospheric effects are present. The measurements from space may be the most accurate means of detecting potential atmospheric dangers.

If the experiment using OAO-3's ultraviolet spectrometer proves feasible, measurements will be made approximately every six months to determine if there is a chlorine buildup in the atmosphere. These measurements will be correlated with measurements made by aircraft, balloons, sounding rockets and later with measurements of even more sensitive instruments aboard future NASA spacecraft. The results of the experiments will be compared with measurements taken from different altitudes in different parts of the world.

Standardization of Spacecraft Components to Reduce Costs

The predecessor of the NASA Standard Space Computer is operating satisfactorily aboard the LANDSAT-2 spacecraft. Launched on Jan. 22, 1975, the computer is carrying out routine operations on the spacecraft. The compact, general purpose computer can handle 55 separate commands programed by ground stations and computer-direct operations for periods up to 24 hours. The miniature computer is the most advanced device of its type flown on an unmanned NASA satellite and can be used on a wide variety of future unmanned satellites.

The Standard Space Computer is part of an agency-wide program, directed by NASA's Low Cost Systems Office, to reduce spacecraft development costs and increase reliability by developing standard satellite components. The standard component program includes items such as nickel-cadmium batteries, transponders, attitude control thrusters, pyrotechnic initiators, silicon solar cells and covers, and standard tape recorders.

Significant savings, in both dollars and manpower, are expected to result from the standard component program during the next decade.

Geodynamic Experimental Ocean Satellite (GEOS-C) Launched

The Geodynamic Experimental Ocean Satellite (GEOS-C) was launched successfully on April 9 from the Western Test Range by a two-stage Delta 1410 launch vehicle. The Delta performance was normal and placed the spacecraft into a near-perfect orbit.

The GEOS-C is the third in a series of spacecraft to extend man's knowledge of the shape and dynamic behavior of the Earth. The spacecraft is designed to measure the geometry of the oceans and to map the topography of the ocean surfaces and the sea state. Using radar altimetry and satellite-to-satellite tracking along with radar, laser, and Doppler tracking, several new and established geophysical measuring systems will be compared.

The Phase A spacecraft and experiment systems checkout was completed on April 20. The Phase B operations and calibration activities began on April 21, as planned.

High Capacity Memory Recorder Under Study

A solid state data recorder under study at the Langley Research Center uses a new recording technique expected to improve the reliability of data storage systems aboard future NASA spacecraft. The recorder is about one-third the size of a conventional magnetic tape recorder, weighs about half as much and requires only half the power. The technology for the recorder is based on the use of microscopic magnetic spots called bubbles which are substituted from magnetic tape in spacecraft recording instruments.

The bubbles exist in special magnetic crystals which are sliced wafer-thin. A thin pattern of magnetic material is overlayed on the crystal so the bubbles can be moved in a controlled fashion to perform specific computer logic functions. The completed crystal is then subdivided into quarter-inch rectangular sections called chips. The recorder at Langley has a 102,400-bit single chip capacity. The memory element is designed for use as a basic building block in a 100-million-bit solid-state data recorder.

The solid-state bubble memory recorder has no moving parts. When the tape breaks on a magnetic tape recorder, the entire recorder stops functioning. The bubble memory recorder is segmented so that, if a single part fails, the unit will continue to operate at a reduced capacity.

Life Sciences Program Participants Sought

NASA is inviting scientists to participate in planning its Life Sciences Research Program for the Space Shuttle/Spacelab missions in the 1980s.

Scientists interested in receiving an invitation should get in touch with the NASA Office of Life Sciences, Code MMC, Washington, DC 20546.

In announcing the invitation, Dr. David L. Winter, Director for Life Sciences, said: "We urge the life sciences community to participate in shaping the scientific objectives, in selecting spacecraft laboratory equipment, and in planning experiments so that the scientific community may take maximum advantage of the unique opportunities for research which will be available in the Space Shuttle/Spacelab."

The Spacelab, to be carried aboard the reusable Space Shuttle, will provide the first opportunity to conduct life sciences research in space, using many standard laboratory instruments and procedures and under working conditions approximating those of laboratories on Earth.

NASA considers life sciences to include all disciplines which seek to understand, measure or control life processes at the sub-cellular, cellular, systemic, organism or multi-organism levels. These disciplines include biology, physiology, medicine, behavioral and social sciences, biomedical engineering, life support systems engineering and human factors engineering.

"Past research has shown that space flight has some effects on living organisms which cannot be duplicated in Earth laboratories or explained by current theories," Dr. Winter explained. "Therefore, studying these effects in space during the next decade will not only add to man's knowledge of space flight, but will undoubtedly produce insights to life processes on Earth."

A Spacelab mission devoted entirely to life sciences

research is planned for every six months in the 1980s. In addition, small automated life sciences experiments may be included on other Space Shuttle missions dedicated primarily to other scientific disciplines.

In addition, free-flying unmanned satellites which can serve as small life sciences laboratories may be launched from the Shuttle. The unmanned laboratories, which will be retrieved and returned to Earth, may include experiments involving animals.

Approximately 50 life scientists will have the opportunity to carry out research in space by serving as crewmen in the Spacelab missions ranging up to 30 days in duration. Up to four scientists will be able to fly on an individual mission, the exact number depending on its duration.

A total of about 200 life scientists may have the opportunity to serve as principal investigators in the overall Space Shuttle/Spacelab program. It is estimated that, in the 1980s, five to seven times as many life sciences experiments will be performed in space as were performed during the entire previous 20 years of manned space flight.

Admiral Woodfin Succeeds Vecchietti

Rear Adm. Woodfin

Rear Admiral Kenneth L. Woodfin, Deputy Chief of Naval Material, will become NASA's Assistant Administrator for Procurement upon his retirement from the Navy in mid-May, Dr. James C. Fletcher, NASA Administrator, has announced.

In his new position, Woodfin will succeed George J. Vecchietti, who retired last December.

An honor graduate of the Industrial College of the Armed Forces, the admiral became Deputy Chief of Naval Material in 1973. His earlier naval assignments included those of Deputy Commander for Controls, Naval Ship Systems Command; Commander, Navy Finance Center, Cleveland; Director, Navy Military Pay System; Associate Director of Finance, Office of Naval Reactors, Atomic Energy Commission; and Comptroller, Office of Naval Intelligence.

Goddard's Days in New Mexico Recalled at Dedication of New Museum Exhibit

The years before World War II, when Dr. Robert H. Goddard, "Father of the Rocket," conducted rocketry experiments in the Roswell, NM, area, were recalled in recent ceremonies dedicating the opening of a special display in the Roswell Museum and Art Center.

Among those who participated were Mrs. Esther Goddard, widow of the rocket pioneer; New Mexico Governor Jerry Apodaca; Congressman Harold Runnels (D-NM); Dr. Harrison H. Schmitt, the only New Mexican other than Astronaut Edgar D. Mitchell to walk on the Moon; and Dr. Robert R. Gilruth, former Director of the Johnson Space Center.

Included in the display were a plaque containing a small basalt rock and a small New Mexico flag brought back from the Moon on Apollo 17; the spacesuit (on loan from the Smithsonian Institution in Washington) worn on the lunar surface by Dr. Schmitt; the Goddard Trophy presented U.S. Senator Clinton P. Anderson, now retired; an oil painting of Dr. Goddard presented by the Atlantic-Richfield Co.; and a print of Dr. Goddard presented by Mrs. Goddard.

The dedication marked the beginning of Roswell's participation in the national Bicentennial program. It was held on the 49th anniversary of the first successful liquid-fueled rocket firing by Dr. Goddard at Auburn, MA.

Life Sciences Laboratory Studies Contracted

The Marshall Space Flight Center has awarded two contracts for parallel studies aimed at defining concepts for Life Sciences laboratories for research in Spacelab.

A contract for $199,500 went to General Dynamics, Convair Division, San Diego, CA, and one for $199,333 to McDonnell Douglas Astronautics Co., Huntington Beach, CA.

Three types of laboratory configurations will be considered during the nine-month studies: Dedicated Laboratory, a total unit on Spacelab dedicated to Life Sciences research; Mini-Laboratories, high-capability Life Sciences laboratories configured to share a part of a Spacelab with units for other disciplines, such as Earth resources and materials processing; and Carry-On Laboratories, units small enough to be carried aboard the Shuttle Orbiter for the study of specific Life Sciences problems.

Each of these three types of laboratories will be designed to accommodate experiments for a wide variety of life forms such as cells and tissues, plants and vertebrates, laboratory rats and other animals and man himself.

Did You Know?

Visitors at Kennedy Space Center and adjacent Cape Canaveral totaled 323,396 during the first quarter of 1975, an increase of 94.5 percent over the same period of 1974. The March, 1975, figure alone was only 9,286 below the total for last year's first quarter.

Meanwhile, Sunday drive-through tours of the Center and Cape Canaveral Air Force Station, closed during February because of a strike by the International Association of Machinists against the McDonnell Douglas Corp., were resumed on April 20, following settlement of the strike.

NASA's flying laboratory, Galileo II, was flown from Ames Research Center to Alaska early in April to participate in a month-long field investigation of the Arctic seas. Researchers hope to find suitable methods of measuring critical changes in that environment.

Marshall Space Flight Center has issued an invitation for bids on construction of a 500,000-gallon fuel oil storage tank for use in operating the central steam plant at the Michoud Assembly Facility at New Orleans.

Nimbus-4, a research and development meteorological satellite launched by Goddard Space Flight Center on April 8, 1970, and designed to last six months, continues to transmit data back to Earth.

Six of its nine experiments are capable of returning data. One sensor transmits total global ozone measurements 24 hours a day.

Rocket test firings will resume at the National Space Technology Laboratories in Mississippi late in May after a lapse of several years. The first Space Shuttle Main Engine (SSME), a test version, has been installed in Test Stand A–1, which has just been activated following modifications.

NASA has selected Air Products and Chemicals, Inc., Allentown, PA, and Union Carbide Corp., Linde Division, New York, NY, for negotiations for the supply of liquid hydrogen under a long-term contract, to be directed by the Marshall Space Flight Center. The principal users are the National Space Technology Laboratories, Bay St. Louis, MS, and the John F. Kennedy Space Center, FL, for testing and launch of the Space Shuttle.

A NASA-sponsored research program is now underway at the Massachusetts Institute of Technology that could someday lead to economical production of hydrogen fuel directly from sunlight. It was stimulated by reports from Japan that such a reaction was possible.

The soup du jour for the three Americans who will travel around the world next July on the ASTP joint mission may be Ukrainian borsch, kharcho, or Russian queen soup. These items are on the menu of the Soviet Soyuz cosmonauts who will take part in the project.

A $334,100 contract for an optical bench and alignment system for an X-ray test facility at Marshall Space Flight Center has been awarded the Perkin Elmer Corp., Boller and Chivens Division, South Pasadena, CA. The facility will be used initially for X-ray verification testing and calibration of X-ray mirrors, telescope systems and instruments for NASA's High Energy Astronomy Observatory (HEAO) program. □

New FRC Spanish-Speaking Coordinator—Mrs. Dora Borjon of Palmdale, CA, formerly employed in the Personnel Office at Flight Research Center, has been appointed the Center's Spanish-Speaking Coordinator. Her new duties will include, among others, developing, implementing and coordinating the Spanish-Speaking Program, as well as involvement with Spanish-speaking community organizations.

Science and Engineering Officials Named at MSFC

James E. Kingsbury

The appointment of James E. Kingsbury as Director and Leland F. Belew as Deputy Director of Science and Engineering at Marshall Space Flight Center has been announced by Dr. William R. Lucas, Center Director.

The Science and Engineering (S&E) directorate is Marshall's in-house research and development organization, consisting of eight laboratories and two offices. It has 2,400 employees.

Leland F Belew

Kingsbury and Belew are veteran members of MSFC and its predecessor organizations, both having joined the rocket development group in Huntsville in 1951.

In his new position, Kingsbury, who has been serving as S&E Associate Director for Engineering and will continue to do so on an acting basis, replaces Richard G. Smith, who was made Deputy Director of the Center last November. Belew has previously served as S&E Deputy Director for Operations, a position now abolished.

Materials Processing Contract Planned

Assistance from the aerospace industry in the development of a high-temperature materials processing facility for use on sounding rockets is sought by the Marshall Space Flight Center.

An 18-month contract is planned for producing a non-flight engineering model and a flight version of the materials processing facility for use on Black Brant VC sounding rockets.

Principal element of the facility will be a furnace system capable of processing a wide variety of materials in the general field of crystal growth, glass processing and metals melting and solidification.

Additional elements include an automatic control system, a heat removal mechanism, a sample quench system that will isothermally cool test specimens at various cooldown rates, and a thermal monitoring system compatible with sounding rocket telemetry to provide furnace performance and sample growth rate data throughout the processing cycle.

Experiments in space processing of materials are to be conducted aboard sounding rockets at the rate of three flights per year from 1975 through 1980. The launch vehicles, Black Brant VC rockets, are to be fired from the Army's White Sands Missile Range in New Mexico to provide up to six minutes of low gravity during the coast phase of each flight. Scientific payloads will be recovered by parachute for ground analysis.

The Marshall Center is managing the project for NASA's Office of Applications. The Goddard Space Flight Center will provide launch and payload recovery services.

ASTP Mission Will Include Electric Furnace

A multi-purpose electric furnace will be taken on the Earth-orbiting Apollo Soyuz Test Project (ASTP) mission next July to demonstrate the effects of weightlessness or crystallization, convection and other materials-processing techniques, all aimed at improving them for future applications.

The furnace is an improved version of one used in the Skylab missions, being capable of higher temperature and more precise control of temperatures.

Hardware design and sustaining engineering for the furnace are performed by the Marshall Space Flight Center. Including the furnace, 10 of the 26 experiments planned to be tried on the mission are to varying degrees the responsibility of MSFC, which also will provide the Saturn IB launch vehicle.

ASTP Furnace—Arthur Boese of the Marshall Space Flight Center examines a prototype of the Multipurpose Furnace to be used during the Apollo Soyuz Test Project to demonstrate the effects of weightlessness on crystallization, convection and other materials processing techniques.

1975 Savings Bond Campaign Underway

The 1975 NASA Savings Bond Campaign began May 1 and will continue through May 30, with a goal of increasing NASA-wide participation to at least 80 percent from the present 73 percent.

This year's Chairman is Dr. James C. Fletcher, NASA Administrator, who personally supports the bond program. In a memorandum to installation Directors and NASA employees, he urges support for the program to the fullest extent possible.

During the campaign, each NASA employee will be given the opportunity to begin buying Series E Savings Bonds through the payroll savings plan, or to increase the amount of his or her present savings bonds deductions. It is pointed out that savings bonds, in addition to their guaranteed interest return of 6 percent when held to maturity of five years, are safe and are easy to buy under the payroll savings plan. They offer tax advantages for retirement purposes and for childrens' education. The interest earned from them is exempt from state and local taxes.

All NASA personnel who have not yet done so are urged to begin at once to "Take Stock in America" and in their own future by joining the bond payroll savings plan during the current campaign.

Design of Spacelab Habitats Sought

The Marshall Space Flight Center has asked 31 aerospace firms for quotations on a conceptual design study for a biological specimen holding facility for Spacelab.

The study will concern design of habitats to be carried in Spacelab to house and maintain live biological specimens to support Life Sciences space flight research programs. They are to be suitable for a wide variety of specimens, but the emphasis will be on the adult rhesus monkey and the adult laboratory rat.

Minimizing physiological changes and stress in the specimens will be a prime criterion in developing the habitat design. Basically, the habitat will consist of the structure and the environmental control, food and watering, waste management, lighting, and specimen instrumentation systems.

ASTP Crew Training in Final Stage

American and Soviet space crews began during April their final joint training session for the Apollo Soyuz Test Project mission in Earth orbit in July.

Eleven U.S. astronauts made the trip to the USSR and were to remain there approximately three weeks, their stay ending in early May. Most of their training was to be at the Gagarin Cosmonaut Center in Star City, near Moscow with a visit to inspect the Soyuz spacecraft at the Baykonur launch site near Tyuratam set for April 28.

The next face-to-face meeting of the prime crews will be on July 17, when they exchange greetings in space after Apollo has docked with Soyuz.

Astronauts who made the trip were:

Brig. Gen. Thomas P. Stafford, Vance D. Brand and Donald K. Slayton, prime crewmen; Capt. Alan L. Bean, Capt. Ronald E. Evans and Lt. Col. Jack R. Lousma, backup crewmen; Lt. Col. Karol J. Bobko, Cdr. Robert L. Crippen, Lt. Col. Robert F. Overmyer and Cdr. Richard H. Truly, support crewmen; and Capt. Eugene A. Cernan, Special Assistant to the Apollo Spacecraft Program Manager.

MSFC to Conduct ASTP Flight Support

Using its Launch Information Exchange Facility (LIEF), the Marshall Space Flight Center will conduct flight support operations for the Apollo Soyuz Test Project (ASTP), the joint mission with the Soviet Union scheduled for July.

The LIEF serves as a communications link between MSFC, the Kennedy Space Center and the Johnson Space Center. It makes MSFC's expertise, as well as that of its contractors, readily available to the other two centers where the launch is conducted and the mission controlled.

Through LIEF, Marshall will contribute to the mission in three areas: (1) launch of the Saturn IB vehicle, provided by MSFC; (2) rendezvous and docking of the astronauts' Apollo spacecraft with the Soyuz spacecraft; and (3) de-orbiting of the Saturn IB's spent upper stage and instrument unit some six hours after launch.

Shuttle Hardware—Engineers at Marshall Space Flight Center's Electronics and Control Laboratory examine the first piece of Space Shuttle engine ground test equipment to arrive for testing. Left to right are Charles S. Cornelius, Mike Kalange and Zack Thompson.

Nature Provides Clues for Solar Energy Conversion

Insect communications and animal eyes have provided a fundamental design clue for a NASA effort to develop a new family of highly efficient solar energy converters for space and earth-bound use.

A basic research grant intended to prove the feasibility of the concept, called Electromagnetic Wave Energy Conversion (EWEC), was awarded during April to the University of Florida by Goddard Space Flight Center.

The University's Electrical Engineering Department will evaluate a technique whereby the Sun's electromagnetic radiation is absorbed by an array of insulated components and converted directly to electricity. The EWEC absorber is structurally similar to that of insect antennae and the retina in the eyes of mammals.

Insects communicate by the transmission and reception of infrared and other electromagnetic radiation or energy. A male moth, for example, tracks a prospective bride by means of her radiated energy with the use of tiny antennae tuned to the proper frequency by nature's design. Once received by the male moth, this energy is converted to electrical impulses which activate its central nervous system, and he responds instinctively as his ancestors have for thousands of years.

Similarly, electromagnetic radiation in the form of visible light is received by the eyes of mammals and focused on minute receptors called rods and cones which comprise the retina. The light is converted to electrical impulses by the retina and transmitted by an optical nerve to the brain, and electro-chemical system, where images are created in the process of seeing.

The chief solar energy conversion technique now under study for earthbound use is the silicon solar cell, an established technology created from the space program. Sunlight impinging upon these smooth-surfaced cells causes electrons to flow and thereby create direct current.

Solar cells presently have a conversion efficiency of about 15 percent. Thus, if 1,000 watts of sunlight fall upon one square meter (39 by 39 inches) of solar cell material, the resulting current output is 150 watts.

The EWEC promises some major advantages over solar cells. For example, early calculations show that the EWEC may have a theoretical conversion efficiency rate of about 50 percent. Mechanical flexibility appears inherent in the EWEC if the absorber elements are mounted on a flexible substrate, while solar cells often crack and lose efficiency if not mounted on a flat surface. And it may be possible, ultimately, to manufacture large-area, low-cost EWEC absorbers on a sheet roll process, a feat of economy not presently achieved with solar cells.

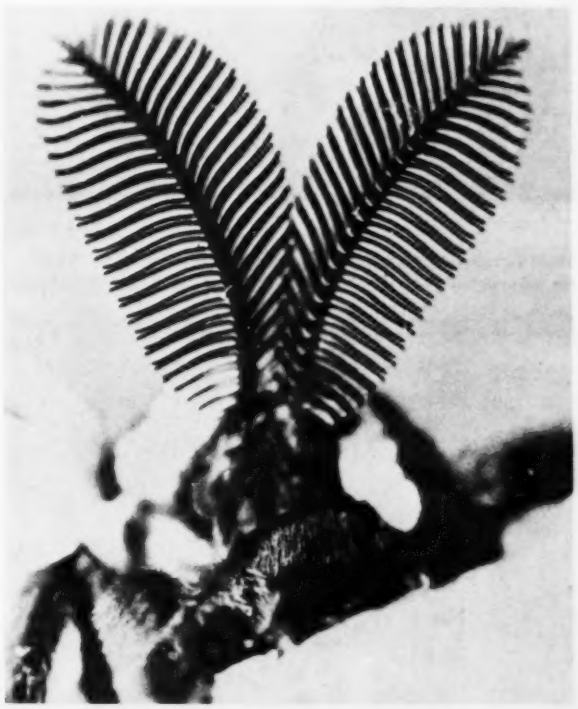
"The EWEC concept offers the only real possible improvement over solar cells that we know about," said Harold J. Peake, Head of Goddard's Aerospace Technology National Needs Office, which administers the EWEC grant. "The $20,000, six-month grant is considered 'seed' money intended to establish the theoretical feasibility of the EWEC absorbers. We need to put it on a sound enough basis to develop design procedures that will allow us to demonstrate the concept."

The EWEC technique was discovered in 1968 by Prof. Robert L. Bailey of the University of Florida while engaged in research at Goddard. It is protected by a NASA patent.

If perfected, EWEC converters are believed to have numerous potential applications of a practical nature. Such direct solar-electric converters eventually could supplement the nation's growing terrestrial need for electric power and permit tapping the only inexhaustible pollution-free energy source—the Sun. Another application may be in the area of early warning radar systems using EWEC-like antennae.

An additional spinoff from this research may accrue to the agricultural area of insect control. The better understanding of absorbers from this research will be directly applicable to insect antennae and eventually could lead to super efficient electronic means of trapping insects to prevent crop and food destruction.

Bug Antennae Set the Pattern—This photo shows—enlarged 10 times— the main center and cross arm supports for tiny antennae on the male Cecropia moth. Goddard Space Flight Center has awarded a grant to the University of Florida in an effort to determine the theoretical feasibility of converting solar energy into electricity through a technique using energy absorbers patterned after nature's design of insect antennae.



Shuttle Engine and Mid-Fuselage Completed

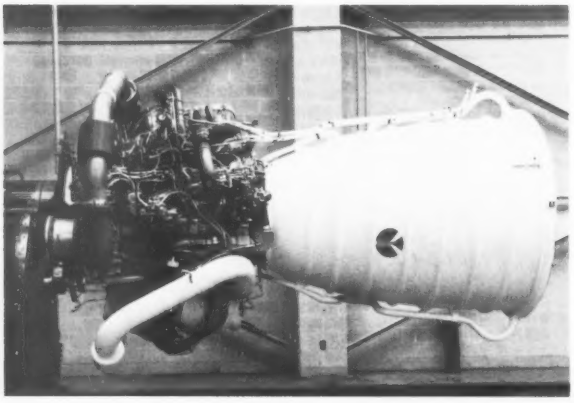
Two important milestones in the Space Shuttle Program—completion of the Integrated Subsystem Test Bed (ISTB) engine and of the first mid-fuselage of the Orbiter—were achieved during March.

The engine is not intended for flight. Fabricated by the Rocketdyne Division of Rockwell International at Canoga Park, CA, it will be used in static firing tests at the National Special Technology Laboratories in Mississippi beginning in May to validate the design of the main engine for the Shuttle Orbiter. It is the most advanced liquid-fueled rocket engine ever built and is designed for multiple reuse.

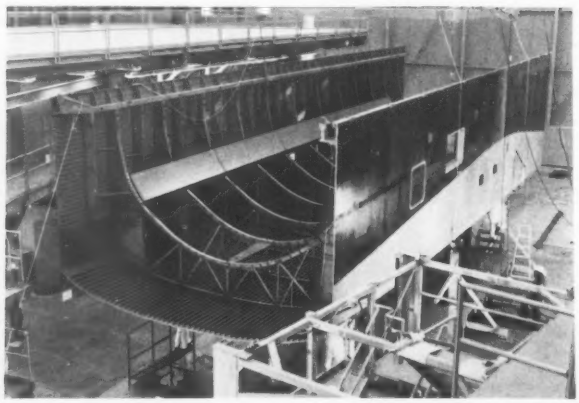
The mid-fuselage was built by General Dynamics in San Diego and has been shipped to the Rockwell Corp. assembly plant in Palmdale, CA. The structure provides the payload bay and will be flown on the first Orbiter.

In 1977, this Orbiter will fly approach and landing tests to insure the success of the second Orbiter, which is scheduled for the first manned orbital flight in 1979.

First Shuttle engine to be completed



Mid-fuselage of the Shuttle Orbiter that will provide the payload bay



Tracking of Satellite by Satellite a Step Closer

Another step toward the tracking and communications control of satellite by other satellites was taken during April in a unique experiment using the Applications Technology Satellite-6 (ATS-6).

Conducted by Goddard Space Flight Center, the experiment involved the tracking of and communications with NASA's GEOS-3 geodetic satellite by the ATS-6.

GEOS-3 orbits the Earth at an altitude of 845 kilometers (524 statute miles), while the ATS-6 is in a stationary orbit 35,680 kilometers (22,300 statute miles) above the equator due south of Kansas City, MO. Spacecraft in stationary orbits remain over the same point on the globe until moved by ground command.

During the experiment, the ATS-6 was first commanded by the ATS ground station in Rosman, NC, to point at and track the GEOS-3. Ranging signals were then transmitted to the ATS-6 for relay to the GEOS-3. Ranging signals were then transmitted to the ATS-6 for relay to the GEOS-3. The ranging signals, along with spacecraft condition and experiment data, were returned to Rosman over the same communications loop.

Even as the GEOS-3 disappeared behind the Earth in its lower orbit, the ATS-6 continued to track a path across the Earth indicating the location of the geodetic satellite. And as the GEOS-3 appeared over the edge of the Earth, the ATS-6 again locked onto it and tracked it for over 50 percent of its orbit. Present ground station tracking of the GEOS-3 can cover only 15 percent of the orbit.

All of the information collected in this and future experiments of a similar nature will contribute to the future transition from a totally ground-based tracking system to a Tracking and Data Relay Satellite System (TDRSS). The TDRSS is presently under investigation for the late 1970s. The system would employ two stationary orbit spacecraft such as the ATS-6 to relay command, tracking, and telemetry data between a few centrally-located ground stations and multiple spacecraft in low Earth orbit.

In July of this year, the ATS-6 will be used in a similar experiment with the Apollo Soyuz Test Project (ASTP), a joint USA-USSR space mission to advance international cooperation in manned flight. During this mission, an Appollo spacecraft carrying three astronauts will rendezvous and dock with a Russian Soyuz vehicle carrying two cosmonauts.

Communications from the crews of the docked Apollo and Soyuz spacecraft, including color TV, will be relayed to the Earth through the ATS-6. Use of the ATS-6 for the ASTP tracking and data relay will provide longer continued periods and about three times the communications covered attainable from ground stations.

By the time of the ASTP mission, the ATS-6 will have been moved to a position on the equator above Lake Victoria in Kenya, East Africa. An ATS ground station in Madrid, Spain, will control the spacecraft.

Following the ASTP mission, the ATS-6 will be used by the Government of India to deliver instructional TV programs to 5,000 isolated villages and cities in seven states for about one year. About 2,400 of the villages will be equipped with small ground stations to receive signals directly from the ATS-6. Another 2,600 or more villages will receive the signals rebroadcast from a ground terminal in the area.

Following the ASTP and Indian experiments, the ATS-6 will be returned to a position over the United States for possible future experimentation.

Veteran Test Pilot McKay Succumbs

John (Jack) B. McKay, veteran test pilot at Flight Research Center who piloted almost all of this country's rocket-powered aircraft, died recently after a long-term illness. He was 52.

McKay retired from NASA in 1971 following a 20-year career as a research pilot specializing in high-speed aeronautical research. He served as project pilot on both the Phase I and Phase II versions of the D-558 Skyrocket and X-1B and X-1E, growth versions of the X-1, the first aircraft to fly faster than the speed of sound.

In 1958, he was selected as one of the original seven pilots for the joint NASA-USAF-USN X-15 flight research program. He piloted the stubby-winged rocket plane 29 times, reaching a top speed of 2,900 miles per hour, almost six times the speed of sound, and a peak altitude of 300,000 feet, or more than 57 miles.

He received in 1968 an injury which subsequently led to his retirement. It occurred when the X-15 he was piloting turned over on its back following an emergency landing made after a malfunction of the rocket engine.

A native of Portsmouth, VA, and a graduate of the Virginia Polytechnic Institute, he served as a U.S. Navy carrier pilot during World War II.

Booster Separation Motor Proposals Asked

Proposals from industry for the design and development of separation motors for the Space Shuttle Solid Rocket Booster (SRB) have been asked by the Marshall Space Flight Center.

The contract will cover design, development, fabrication, test, inspection, checkout and delivery of hardware required for the first six test and evaluation flights of the Shuttle.

Each of the two Solid Rocket Boosters will have eight booster separation motors, four in the nose cone and four near the aft end. They will fire after separation on the SRBS from the External Tank at an altitude of about 43.5 kilometers (27 miles).

Student Emblem Winner—Peter P. Purol (left) of Baltimore, MD, discusses with Dr. James C. Fletcher, NASA Administrator, the entry with which he won the national Viking Student Emblem Contest.

Baltimore Student Wins Viking Contest

Peter P. Purol of Baltimore, MD, a junior at Dundalk Vocational Technical Center, has been chosen national winner of the Viking Student Emblem Contest sponsored by NASA and the National Science Teachers Association.

The emblem he designed will be borne by the Viking spacecraft scheduled to touch down on the surface of Mars July 4, 1976. It was selected from among thousands submitted by students throughout the United States.

The 17-year-old student and his sponsoring teacher, Edward Dyson, will be special guests of NASA at the Viking launch this summer. They also will attend an expense-paid Viking Educational Conference at Kennedy Space Center.

This space agency also will award special medallions to Purol and to his school.

Open to any American high school student, the Viking contest required an original design and a brief essay of its significance. Purol's emblem, in red, white and blue, links the Vikings of old with the Viking to Mars.

In addition to Purol and Dyson, 12 national finalists from each of 10 regions of the United States also will attend the Viking launch and educational conference, along with their teachers. They also will receive special medallions.

Air and Space Seminar Held

An informational seminar designated as "NASA Symposium '75," with workshops, exhibits and lectures designed to disseminate information on the aerospace industry and space program to the state's minority community, was held at Shaw University, Raleigh, NC, April 21–25.

Upper elementary, junior high and high school students from schools within a 75-mile radius of Raleigh were brought into the city by bus to view the exhibits and attend lectures. In addition, college students were given an opportunity to meet and talk with prominent minority scientists and engineers who hold vital positions both in NASA and in the private sector of the aerospace industry.

Dr. James C. Fletcher, NASA Administrator, attended the symposium and met with the heads of the state's minority colleges and universities.

The NASA program, with Langley Research Center acting as co-sponsor, was directed by Dr. Harriett G. Jenkins, Assistant Administrator for Equal Opportunity Programs. She listed these objectives:

- To provide the minority college student with a wide exposure to and a greater appreciation of the potential that lies within the career fields of science, engineering and technology.
- To assist minority institutions in recognizing and understanding the opportunities for participation in various institutional assistance programs operated by NASA.
- To stimulate the interest of the upper elementary, middle school and high school student in these career fields.
- To share with the community the various ways in which space-age technology has contributed to the improvement of the quality of life on spaceship Earth.

Planning North Carolina Symposium—These three officials played a leading part in arranging the informational seminar, "NASA Symposium '75," held at Raleigh, NC, April 21–25. Left to right, they are Roscoe Monroe, NASA Community Relations Officer; Dr. J. Archie Hargraves, President of Shaw University, at which the seminar was held; and Ben Smith, Langley Research Center Community Relations Officer.

Administrators Assure LeRC's Role in Efforts to Solve Energy Crisis

Letters to President Stimulate Reply for NASA and ERDA Heads

The role of the Lewis Research Center at Cleveland, in the national program to solve the nation's present energy crisis was made clear in a recent letter signed jointly by Dr. James C. Fletcher, NASA Administrator; and Dr. Robert C. Seamans, Jr., Administrator of the Energy Research and Development Administration (ERDA).

The letter was directed to members of Congress from Ohio and to prominent Cleveland businessmen and industrialists who recently wrote President Ford urging that greater use be made of LeRC in meeting the energy crisis.

The Lewis Center already is involved in a number of projects under ERDA sponsorship in solar heating and cooling, wind energy and topping cycles to increase the efficiency of coal-fueled steam plants. During March, moreover, about 250 technical managers from gas utilities and their suppliers were invited there to a conference on selected technology for the gas industry.

The letter from the two Administrators follows:

"This is in response to your letter of Feb. 4, 1975, to the President, in which you and the other members of the Ohio Congressional Delegation urged that we assess the potential for utilization of NASA's Lewis Research Center as an important part of the Energy Research and Development Administration's efforts to carry out a strong and balanced energy R&D program.

"Under its charter, the newly formed ERDA is the lead Federal agency for managing a coordinated national energy research and development program. In carrying out its overall program, ERDA intends to utilize the unique expertise and facilities of other Federal agencies where such utilization is feasible and in the national interest with respect to cost, timeliness, program management, or other important factors. The expertise and facilities of LeRC, as well as other NASA Centers, are being considered by ERDA as part of its overall definition of a total institutional structure required to carry out the nation's energy R&D program.

"LeRC is NASA's lead Center for the development of basic aeronautical and space propulsion technology. For some time, in addition to carrying out its principal mission, the Center has been engaged in exploratory research to apply the principles of aeronautical and space propulsion technology to surface transportation and other terrestrial applications.

"LeRC will continue to be NASA's lead Center for propulsion technology. However, we also anticipate that it will conduct exploratory energy research in support of ERDA consistent with the requirements of its principal mission within NASA. ERDA and NASA are currently

involved in discussions aimed at establishing close working relationships to permit rapid transfer of space and aeronautical-related technology to energy applications. We assure you that LeRC is receiving, and will continue to receive, careful consideration with respect to its role in the Federal government's energy R&D program.

"We appreciate your interest in this matter and will keep you informed as LeRC's role in energy R&D is further defined."

NASA Awards Contract to Improve LACIE

NASA is taking steps to augment existing computing capability for its Large Area Crop Inventory Experiment (LACIE), the goal of which is to determine if wheat production forecasts can be improved by using satellites in Earth Orbit.

An important action in this direction was the recent award of a $1,388,498 firm-fixed-price contract to the Goodyear Aerospace Corp. of Akron, OH, for the design, fabrication, delivery and installation of a Special Purpose Processor (SPP) and associated system software to improve computing capability. Acceptance date for SPP is Dec. 30, 1975.

LACIE is a three-way project involving the U.S. Department of Agriculture, National Oceanic and Atmospheric Administration and NASA. It will start with North American wheat fields and, if results are successful, the project will expand to include other wheat-growing areas of the world.

Soyuz Launch Failure Discussed

Prof. Konstantin D. Bushuyev of the USSR and Dr. Glynn S. Lunney, Technical Directors for the Apollo Soyuz Test Project (ASTP), recently discussed the April 5 Soyuz launch failure during one of their regular telephone conferences.

Bushuyev, according to Lunney, reported that the launch vehicle involved was one of the earlier versions of the booster used in their national program and added that the ASTP booster is a modernized version with greater payload capability.

"The Professor said the failure is still being analyzed," Lunney reported, "but he positively assured us that it will not affect our joint program or the July 15 launch date.

"He said there is no doubt about systems that are common in the old and modernized ASTP versions of the booster. He said that there are differences in the two versions and that the ASTP version has been used successfully in previous flights.

"I told him that I wanted more details on the problem, and he agreed to provide them to me by telegram after their analysis is developed further. We also agreed to discuss this subject further when we next meet in Moscow before the ASTP mission."

Nevada Governor Holds up Space as Example for Peace in Universe

"We reached the Moon despite our shortcomings. We can open up the universe if we overcome our distrusts and make ours a world of respect."

These were the words of Governor Mike O'Callaghan of Nevada in addressing some 400 members of the Knights of Columbus at a recent "World of Respect" banquet at Ely in that state.

His remarks were inspired by the earlier presentation by Astronaut Harrison H. (Jack) Schmitt of lunar rock samples to be displayed in the Nevada State Museum at Carson City.

"I have been fortunate in being able to talk with several of America's astronauts—Schmitt, Gene Cernan, Alan Shepard, Stuart Roosa, Ed Mitchell and others," Governor O'Callaghan said. "They echo an idea that we should all consider.

"When you get out there in space, on the way to the Moon, you can look back and see the whole Earth at one time. From space, the polluted air over cities doesn't show. The fouled waters are clear. Clouds drift in large formations, clean and white. What you see is one little ball flying through space in a definite orbit, all orderly and welcoming.

"When those people come back, they don't think of America any less patriotically than the rest of us. If anything, they have a greater respect for what the country can accomplish. But they have a deeper understanding of the way we, as people fit into the framework of the world as a planet.

"Race . . . religion . . . physical ability . . . age . . . intelligence levels . . . all these become artificial barriers, sought out to protect us from our own inadequacies.

"But if we recognize individual worth . . . if we accentuate the positive . . . a whole new world of respect open before us."

Astronaut Schmitt (center) presenting Moon rocks to Governor O'Callaghan of Nevada.

Spacelab Tunnel Tested at MSFC

An early concept of a flexible tunnel, to connect the Space Shuttle Orbiter's airlock with the forward end of the Spacelab and provide a pressurized passageway for crew members and scientists, is now being tested at the Marshall Space Flight Center.

The funnel folds accordion-like to a length of only two feet, but extends to nearly 15 feet. It is four feet in diameter.

When the Orbiter's payload bay doors are open, the transfer tunnel, which will permit personnel to move to and from the orbiting space laboratory without having to don pressurized space suits, and the Spacelab will be exposed to the space environment, including vacuum, low temperatures in shade and high heat on the sunlit side, and possibly meteoroids.

Tunnel for Spacelab—Dr. Mary Helen Johnston, a metallurgical engineering specialist at the Marshall Space Flight Center, checks the interior of a prototype transfer tunnel now undergoing tests for use on the Spacelab.

Dr. Petrone Transfers to Resource Recovery Program

Dr. Rocco A. Petrone, who began his career with NASA in 1966 as Director of Launch Operations at the Kennedy Space Center, has resigned, effective in May, to become President and Chief Executive Officer of the National Center for Resource Recovery.

The National Center is a joint industry and labor endeavor to develop and encourage means to recover materials and energy from solid waste.

"I believe the recycling of our resources presents one of the great challenges of our times," Dr. Petrone said in announcing his resignation. "The energy crunch and the depletion of our resources point up very positively the need for man to be responsible to his environment — both in what he takes from it and what he returns to it. I look forward in my new position to seeing what I can do to meet this challenge."

Dr. James. C. Fletcher, NASA Administrator, made the following comment concerning the resignation:

"We at NASA deeply regret seeing Rocco leave. He has played a vital role in the space program from the development of the Redstone to the completion of Skylab. We wish him well in his new job."

Dr. Petrone came with NASA after serving for 20 years with the U.S. Army, taking part in the development of the Redstone, the nation's first ballistic missile. In September, 1969, after more than three years at Kennedy Space Center, he was transferred to Headquarters and made Director of the Apollo Program. In December, 1972, he was appointed Director of the Marshall Space Flight Center and served in that capacity until March, 1974, when he returned to Headquarters as Associate Administrator and was made responsible for the overall planning and management of NASA's research and development program.

JPL Magazine Wins Honors—LAB-ORATORY, the Jet Propulsion Laboratory's bi-monthly employee magazine, earned top honors in the 1975 PRo Awards Competition in the "continuing publications" category sponsored by the Publicity Club of Los Angeles. Admiring the silver bowl trophy are R.C. House (right), Editor, and B.E. Terry, Associate Editor, the latter a JPL academic part-time employee attending the University of Southern California School of Journalism.

Lundin Cites Communications Satellite as "Nervous System of Mankind"

Commencement Speaker Is Presented an Honorary Doctor of Engineering Degree

The advent of the communications satellite was recently described by Dr. Bruce T. Lundin, Director of Lewis Research Center, as "becoming the nervous system of mankind."

He made the statement in an address before students of the University of Toledo at their winter quarter commencement ceremony, at which he was presented an honorary Doctor of Engineering Degree for his work in improving jet engine performance and for his responsibility in developing the Atlas Centaur launch vehicle, the world's first hydrogen-fueled rocket, used for the Pioneer 10 and 11 unmanned space probe to Jupiter.

After touching upon recent important technical developments, Dr. Lundin told the students:

"We are entering a revolution in human progress—though being in it makes it the harder to see—a revolution as profound as was the industrial revolution of the 18th century. It is nothing less than the final joining of all that is moral with all that is material. And you, with the power you have inherited and with the enlightened values you can bring to the task, have much to contribute here.

"The years ahead will offer unusual opportunities to use our skills in the development and application of technology both at home and abroad. Throughout the world, a rising competition among the industrialized nations for the resources and the markets of the rest of the world will become increasingly a challenge and an opportunity.

"This emerging third world, rich in national resources and greatly in need of industrialization to raise the quality of life of its people, now earnestly wants what we have. No longer shut off from the rest of the world, they now see, via communications satellite and our global transportation system, what we have and want in the 20th century. And they will get it from whomever they can."

He cited America's technology as its top card in the global power game and described it as both superior and highly marketable.

"If we are now to use it in the world, if we are now to share it with others—and I would say we must—I am frequently asked at what price," he continued. "My answer is at the price of peace plus, of course, some reasonably fair economic exchange. To require the price of peace may buy us time to develop a stable world and to provide an opportunity for continued development."

Working in the nation's favor in this respect over the long term, he said is the growing unity of the world and its rapidly shrinking and, in a way, physical dimensions.

"This growing interrelationship among the countries and cultures of the world," he added, "is not the result of any action or power of the United Nations but simply the inevitable outcome of the rise of multi-national industries, the necessary sharing or trading of resources around the world, by the development of air transport and by the advent of the communications satellite."

He described these developments as "tools of technology" and said the development and acceptance of the satellite had been the most impressive.

"If any of you have studied the work of our founding fathers through reading their letters to each other, as I have recently," he continued, "you cannot fail but become impressed with the great handicap imposed upon them by the several months time that was required for an exchange of letters across the ocean. When Benjamin Franklin was our Ambassador to France during the Revolutionary War, many times his work was overtaken by events simply because he had no way of knowing."

Lundin described the benefits of the communications satellite in extending to remote areas educational and medical services, as well as cultural material and entertainment, as an example of the total potential of present-day science and technology.

"We stand today," he said, "with capabilities undreamed of 1,000 years ago and unforeseen 100 years ago. These are capabilities—and we need them—but they are capabilities in human hands and they must serve human purposes. The glittering promise and the awesome problems of the future come hand in hand, and to deal with both will require men and women who are both highly trained and well educated. Science, and its power, and its products, have now entered the mainstream of our lives; it is important that the practitioner of this art be not only skilled in his trade but also familiar with the literature, history, arts and the political and social heritage that form our civilization."

Honorary Doctorate—Dr. Bruce T. Lundin (right), Director of Lewis Research Center, is congratulated by Dr. Glen R. Driscoll, President of the University of Toledo, upon the former's receipt of an honorary Doctor of Engineering Degree.

JSC Awards Contract for Astronaut Shuttle Maneuvering Unit Design

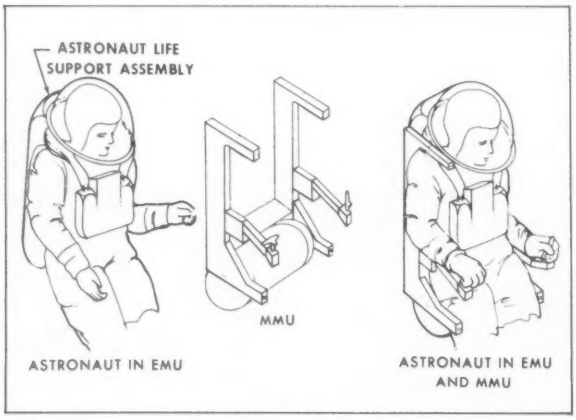
A $373,000 study contract for the conceptual design of an astronaut maneuvering unit for use in the Space Shuttle program has been awarded to the Martin-Marietta Corp., Denver, CO, by the Johnson Space Center.

The corporation has been asked to investigate the application of current and emerging technology and to develop several conceptual designs of a Manned Maneuvering Unit (MMU). After NASA selects the most promising concept, Martin will perform a detailed system design and fabricate a high fidelity mockup of the MMU and its support station, as well as a set of prototype MMU hand controllers.

The MMU is a direct spinoff from the eight-month-long Skylab program concluded in February, 1974. The highly successful experimental M509 Maneuvering Unit flown on that mission demonstrated the extreme precision and control with which an astronaut wearing a space suit and life support equipment can maneuver in zero-g and perform useful tasks. It also provided the preliminary design criteria for the Space Shuttle MMU.

The new MMU will enable crewmen to move around outside the Shuttle Spacecraft, performing tasks such as inspection, maintenance, repair, retrieval, assembly and photography in support of the Shuttle and its payloads.

The MMU will be shaped like a horseshoe and designed to fit around the Extra Vehicular Activity (EVA) life support backpack. This approach allows the MMU to be donned readily for the EVAs in which the crewmen must reach areas outside the Shuttle payload bay.



New Flight Research Center Director—Dr. David R. Scott (right) is shown with NASA Dr. Alan Lovelace, Associate Administrator for Aeronautics and Space Technology, after the announcement of Scott's appointment as FRC Director.

Scott Succeeds Scherer at FRC

Dr. David R. Scott, Deputy Director of the Flight Research Center since August, 1973, has been named its Director, succeeding Lee R. Scherer, who left in January to become Director of the Kennedy Space Center, FL.

Scott had been serving as Acting Director since Scherer's departure. Announcement of the appointment was made by Dr. Alan M. Lovelace, Associate Administrator for Aeronautics and Space Technology.

The Flight Research Center at Edwards, CA, is NASA's major field center for the flight testing of high speed aircraft and other experimental vehicles. The approach and landing tests of the Space Shuttle, as well as the recovery of the spacecraft form the initial orbital flights, will take place there.

A retired Air Force colonel with more than 5,300 hours of flying time, Scott flew on the Gemini 8, Apollo 9 and Apollo 15 missions. After leaving the astronaut corps in 1972, he was named Technical Assistant to the Apollo

Program Manager at Johnson Space Center. He later served as Special Assistant for Mission Operations and Government Furnished Equipment in the Apollo Spacecraft Program Office.

On the Gemini 8 mission in 1966, he and Command Pilot Neil A. Armstrong performed the first successful docking of two vehicles in space. As command module pilot for Apollo 9 in 1969, Scott was instrumental in completing the first comprehensive earth-orbital qualification and verification test of a fully-configured Apollo spacecraft. In 1971, he commanded Apollo 15, the fourth manned lunar landing mission, and was the first to visit and explore the Moon's Hadley Rille and Apennine Mountains.

He received a Bachelor of Science Degree from the U.S. Military Academy in 1954, ranking fifth in a class of 633. Later, from the Massachusetts Institute of Technology, he received a Master of Science and an Engineering Degree in Aeronautics and Astronautics. The University of Michigan awarded him an honorary Doctorate of Astronautical Science in 1971.

Thole Receives Astronautics Engineer Award

John M. Thole

John M. Thole, who only a few months ago transferred from his position as Project Manager for the Applications Technology Satellite at the Goddard Space Flight Center to that of Deputy Associate Administrator for Space Science at Headquarters, was awarded the 1975 Astronautics Engineer Award of the National Space Club at the annual Goddard Memorial Dinner in Washington on April 11.

The award, established in 1959, is given annually to an accredited engineer for his personal contribution to astronautics. Thole was cited for his leadership of the Orbiting Solar Observatory and the applications Technology Satellite-6 Programs.

Others from NASA who have received the award in the past include Charles W. Mathews, Dr. George M. Low, Dr. Rocco A. Petrone, Dan Schneiderman, Wilfred E. Scull and William Schneider.

Hundreds Gather as Mariner 10 Stamp Goes on Sale at JPL

The Jet Propulsion Laboratory's von Karman Auditorium became "post office for a day" on April 4 as the Mariner 10 mission to Venus and Mercury was commemorated by the issuance of a 10-cent U.S. postage stamp.

The public was invited to the sale, as well as to a first-day-of-issue ceremony on JPL's Central Mall.

The long and fruitful voyage of Mariner 10 spanned three calendar years, ending March 24 when the spacecraft's radio transmitter was turned off by commands from JPL. Eight days earlier, Mariner made its third rendevous with Mercury, passing 198 miles from the planet's surface.

The U.S. Postal Service printed 140 million of the Mariner 10 stamps. Artist Roy Gjertson of San Diego designed the colorful stamp, which depicts the Mariner spacecraft in flight, with Venus and Mercury in the background. The stamp was the first ever issued through the Pasadena Post Office.

The joint JPL-Postal Service ceremony included remarks by J.T. Ellington, Jr., Senior Assistant Postmaster General; Walker E. Giberson, Mariner Project Manager; Dr. William H. Pickering, JPL Director; and Mrs. Katheryn S. Wilson, Pasadena Postmaster.

The Third Marine Aircraft Wing Band of El Toro, CA, and the Caltech Glee Club provided musical selections.

Ford Presents Goddard Trophy to Skylab Crews

The Dr. Robert H. Goddard Memorial Trophy, premier award of the National Space Club, was presented by President Ford to members of the three Skylab crews at the White House on April 11.

The award is given each year as a memorial to the late rocket pioneer, customarily at the annual Goddard Memorial Dinner held in Washington.

Col. Gerald P. Carr, member of the third Skylab crew, was designated to accept the award on behalf of his comrades. President Ford said at the time of the presentation:

"Let me say it is a great honor to participate in the award on behalf of the National Space Club. The Robert Goddard Award, of course, everybody knows, is the ultimate in recognition for great achievement in the field of space.

"I looked over the list of previous recipients, and it is a superb group of individuals, individuals who have contributed most significantly over a long, long period of time, relatively speaking, to the success of our space program.

"I can recall very vividly when the first vehicle was put in space — not by us, but by one of our competitors — and I can recall very vividly the relatively small part that I played thereafter as a member of the Select Committee of Congressman Teague, in putting together the new organization which we know now as NASA.

"As a result of the reorganization of NASA and the excellent leadership that followed by the space commmittees and NASA itself, the United States has achieved a great role in space.

"The Skylab is a great accomplishment, and it has proved, as all of you know, a number of things: first, that man can live in space 84 days, preceded, of course, by two other missions that went from 22 to 54 days.

"In addition to proving that man can live in space, it brought back, through the three missions, information that is invaluable. We know a great deal more about space as a result.

"We have continued the great thrust of our space program, and I wish to congratulate the leader of the third mission, congratulate him and in turn congratulate the other eight individuals who participated in these three historic missions.

"I am glad to report that, through Jim Fletcher's strong plea, we have funded the space program reasonably generously. Let me say that we will help in every way we can to convince the Congress that they ought to keep it at that level.

"Because of my experience both on the Select Committee that had some part in launching our space program, and through my experiences, as Tiger Teague knows, on the Defense Appropriations Committee where we did a good bit of funding for our related military operations, I am a complete believer in the accomplishments — the mission — of a good, fine, forward-looking visionary space program for America.

"I am delighted to congratulate you, Colonel Carr, and let me read the citation as a part of the award given by the National Space Club here. The citation reads:

" 'The Robert H. Goddard Memorial Trophy is presented to the nine Skylab astronauts for their exceptional accomplishments in the Skylab program. They demonstrated that man can live in space for an extended period. They established beyond question the pre-eminence of the United States in space exploration.' "

The President added: "It is agreat tribute to the nine who have participated. It is a great tribute to the people in NASA. It is a tribute, I think, to the Congress and Administration, and Executive Branch, and it is basically a reward for the faith that the American people have had in what we have to do in looking skyward, down the road, for a bigger and better world in which we can all live.

"Congratulations."

Recipients are selected annually "for great achievement to advance space flight programs contributing to United States leadership in aeronautics." Previous NASA winners include Dr. Wernher von Braun, 1958; Dr. Robert R. Gilruth, 1962; Lt. Col. John H. Glenn, Jr., 1963; Dr. Hugh L. Dryden, 1964; Dr. William H. Pickering, 1965; Dr. Robert C. Seamans, Jr., 1968; Col. Frank Borman, Capt. James A. Lovell, Jr., and Lt. Col. William A. Anders, 1969; Neil A. Armstrong, 1970; James E. Webb, 1971; and Dr. George M. Low, 1973.

Goddard Trophy Ceremony—President Ford presents the Dr. Robert H. Goddard Memorial Trophy of the National Space Club to Col. Gerald P. Carr, who received it for three Skylab crews. At the right is Congressman Olin E. Teague (D of TX), Chairman of the House Committee on Science and Technology.

Weather Satellite Award—Michael Garbacz (right), NASA's Program Manager for the Operational Meteorological Satellite Program, receives an award from Dr. Robert White, Administrator of the National Oceanic and Atmospheric Administration, on the occasion of the recent 15th anniversary of the launch of TIROS-1. The award was made in recognition of vital contributions to the overall success and continuity of the Operational Weather Satellite Program.

NASA Is Reported to Be Well Along With New Standardization Program

Effort Is Expected to Result in Great Cost Saving benefits

Joseph L. Murphy

In a move designed to reach new levels of economic competence for reducing the cost of space transportation systems, spacecraft, payloads and electronic parts, NASA has started a parts standardization program that is expected to be in full force before the year ends.

It was described recently by Joseph L. Murphy, Manager of the NASA Standard Parts Program, in a talk before the Space Systems Microelectronic Seminar held in Los Angeles, CA.

According to Murphy, NASA anticipates great benefits from the program. In taking initial steps in this direction, the agency organized a NASA-wide standard parts effort and joined the Department of Defense (DOD) as a partner in the Defense Standardization Program (DSP). It is pointed out that by using DSP specifications and standards, incorporating NASA requirements and experience, NASA is participating in a program that is widely known and accepted by industry. The DSP could become a "National Standard" if every one (other agencies) participated in its development and utilization, controlling the departures from its specifications and standards.

Participation in the DSP originated with an agreement between NASA and the DOD for microcircuits and semiconductor devices, later expanded to cover resistors and capacitors. This agreement is recorded as a memorandum of Understanding and issued as NASA Management Instruction (NMI 1052.164A).

Here are quotations from Murphy's talk:

"A NASA-wide standardization program for the procurement of microcircuits and other electronic parts has been established. Through standardization, NASA has elected an important means to cope with small quantity buys, high cost, long delivery schedules, market influence and fluctuation, part failures and expensive rework.* * *

"There are numerous examples where the cost of correcting problems have reached as high as 100 times the cost required to have initially prevented the application of poor quality parts.* * *

"An intensive effort between NASA and the Air Force Space and Missile System Organization (SAMSO) has been underway for the last 18 months, developing joint space quality and reliability requirements for microcircuits, transistors and diodes. The results of the Microcircuit effort is reflected in the forthcoming reissue of specification MIL-M-38510 and MIL-STD-883. Joint transistor and diode requirements are still under development and should be released to the DSP in the near future.

"Microcircuits have, over the last 12 years, been of special interest to NASA. Their inherent high reliability and small size, weight, and power requirements caused NASA to be a pioneer user. NASA Management encouraged an early coordination of effort among its Field Centers in both the areas of research and development, and reliability. A supporting research and technology program was established in 1964 for microelectronics. * * * These activities are directed by the Headquarters Office of Aeronautics and Space Technology and performed by the Field Centers.

"Responsibility for the coordination of microelectronics reliability efforts was established in the Office of Reliability and Quality Assurance (ORQA) in early 1963. Through the NASA Parts Steering Committee (NPSC), chaired by ORQA, a forum for the exchange of information and experiences, assistance in planning, and the development of microcircuit requirements for procurement was established. * * *

"At the time DOD decided to change its policy and issue a general specification for microcircuits, NASA was about to issue its own general specification, including associated

reliability and quality standards. Recognizing even then the importance and potential impact of a single set of Government standards, NASA dropped its general specification development and joined DOD, issuing only the Line Certification, NHB 5300.4(3C), and the supporting Test Methods and Procedures, NHB 5300.4(3D), documents. * * *

"A recent NASA Policy Directive, NPD 5320.5, May 7, 1974, provides the basis for the establishment of the NASA Standard Parts Program. It addresses selection, procurement, testing and application of microcircuits, transistors, diodes, capacitors, and resistors. * * * The intent of the Directive is to increase the availability of fewer parts and to reduce overall costs to NASA; eliminating duplication of effort among our NASA Field Centers, prime contractors and subcontractors. * * *

"The present standardization efforts of NASA and DOD are already supporting the Space Shuttle; it will contain mature, controlled Class B microcircuits with proven histories which are readily available from industry for most applications. Class A microcircuit utilization will be limited to specific applications when the highest level of quality and reliability are required to ensure mission success. * * *

"Management, recognizing the additional cost benefits that could be derived from NASA-wide consolidated buying and stocking, made provisions in the policy for its study. * * * HEAO, Viking, Pioneer/Venus, Mariner/Jupiter/Saturn projects have or are trying various concepts of consolidating or open order buying. The Goddard Space Flight Center has forecast its C-MOS microcircuits requirements for in-house projects and has let a consolidated-buy contract valued at least for $2.3 million. * * *

"The Marshall Space Flight Center was designated in May, 1974, as the Lead Center for the NASA Standard Parts Program to perform the centralized functions in May, 1974. Within MSFC, a lead Center Office has been established to provide effective leadership in ascertaining NASA-wide needs in a timely manner and responsing to them in a fully coordinated and impartial manner. * * *

"The Lead Center Office is also the central point for coordination within NASA, with the DOD and others. It will provide direct interface with DOD specifications preparing and user organizations, the Defense Electronics Supply Center (DESC), DOD Contract Administration Services (DCAS) field offices, industry and industry associations.

"The NASA Field Centers (users) are required to develop internal procedures and instructions for implementing the NASA Standard Parts Program for in-house and contracted work and for interfacing with the Lead Center. They are required to select and use the standard parts from the NASA Standard Parts List (NSPL), using the listed specifications and other documents for part purchase and control. * * *

"NASA Standard Parts will be listed in MIL–STD–975. This is a new limited coordinated standard assigned to NASA by DOD and it is expected to be released by August, 1975. It will contain the microcircuits, transistors, diodes, capacitors and resistors typically selected from high reliability military specifications. * * *

"Although MIL–STD–975 is intended initially to satisfy NASA's requirements, coordination with SAMSO and others is highly desirable. For transistors and diodes, the selected candidates for the Standard are, for the majority, from the NASA/SAMSO device list prepared for the Rome (NY) Air Development Center's test and evaluation effort. * * *

"For Class A microcircuits, line certification is required as a prerequisite to the conventional qualification. The purpose of line certification is to provide additional reliabilty assurance — by holding within established limits — the manufacturing process and material controls at critical points during manufacture.

"Line certification is a detailed evaluation, by a NASA team, of the key process steps developed and used by the manufacturer from wafer fabrication through part assembly. Each selected process step is certified only upon demonstration that it provides proper and adequate control. * * *

"In over four years of operation, Line Certification has been successful. There are now 11 certified Class A lines involving seven manufacturers being maintained by NASA. Most manufacturers have found that their certified lines produce a better product with higher yield. * * *

"Historically, the Government places on its individual projects most of the responsibility for assuring that manufacturers are providing quality products. This, many times, results in multiple Government and contractor source inspections at a given plant. The duplicative effort is very costly. Numerous projects decide against source inspection due to its drain on resources or lack of confidence in source inspection itself. Thus, problem identification can only be hoped for during independent inspection and screening — again a potentially costly venture — or worse during system test. To share the responsibility with projects, an organized cost effective effort is needed, independent of individual orders.

"For microcircuits, this type of effort is underway. NASA teams, on the average of three months, are returning to each certified wafer processing and assembly area to assure that process controls are maintained. * * * NASA is presently developing a list of monitoring and inspection requirements for DCAS to perform on a routine daily/monthly basis for process control (line) maintenance, thereby filling the gap between NASA team visits.

"With increased demand for their products, NASA anticipates that the industry will be more responsible to its needs. Additional response is expected as NASA and SAMSO continue development of joint space requirements. By encouraging others to join the Defense Standardization Program for microcircuits and other electronic parts, it could become a "National Standard" for procurement — a highly desirable objective."

Radio-Television

(Released Nationally)

May

Television—A two-story color film release in the monthly *Aeronautics and Space Report* television series, "Landsat—Earth Resources Satellite," (NSTL/Gary North); and "Helicopter Crashworthiness Test."
Radio—Four weekly *Space Story* programs have been released: "Meteorological Satellites," (GSFC/Bandeen); "Space-Age Utility System," (JSC/Hays); "Shuttle Launch Preparations," (KSC/Gray); and "Weather Mappers on Mars," (TRW/Adelson). One set of ten 60-second informational announcements, *NASA Space Notes*, are to be released.

NASA Film Activity

The NASA film "Jupiter Odyssey" has been awarded a CINE Golden Eagle certificate in national competition. This award entitles the film to represent the United States in international motion picture events abroad.
The third film in the "Rediscovery" series has been released. It is entitled "Earthquake Below." The first two films in the series are on hurricanes and tornadoes.
The NASA film "Who's Who Out there?" was honored with a "Silver Screen Award" from the U.S. Industrial Film Festival in Chicago. This is a second award with over 500 entries in competition.

Lunar Sample Exhibits

The following is a schedule of lunar sample exhibits from May 15 to June 15, 1975:

Alabama—U.S. Army Bicentennial, Anniston, May 17.
Illinois—St. John's School Picnic and Carnival, Belleville, June 7–8.
Indiana—Aerospace Display, Fort Wayne High School, May 24; American Freedom Train, Indianapolis, June 12.
Michigan—Michigan Week, Ferndale Michigan Library, May 17–24.
Ohio—Armstrong Air and Space Museum, Wapakoneta, May 29–Sept. 4; American Freedom Train, Columbus, May 22, Cincinnati, June 4.
Texas—Houston Museum of Natural Science/History, End of Caroline at Hermann Park, Houston, May 15–June 15.

Long Term Displays

Alabama—Alabama Space and Rocket Center, Marshall Space Flight Center, Huntsville.
Florida—Visitor Information Center, Kennedy Space Center.
Kansas—Eisenhower Library, 400 SE 4th Street, Abilene.
New York—United Nations Building, New York City.
Ohio—U.S.A.F. Museum, Wright Patterson AFB.
Texas—Johnson Library, University of Texas, Austin; Visitor Information Center, Johnson Space Center, Houston.
Virginia—Visitor Information Center, Langley Research Center, Hampton.
Washington, DC—National Geographic Museum; Smithsonian Institution, National Air and Space Museum, 1000 Jefferson Drive; Washington National Cathedral.

Headquarters Press Releases

(Issued by the Public Information Division, Code FP, Headquarters, Washington, DC 20546. These releases are available only to members of the news media.)

75–48 Technology Essential to World Leadership
75–49 Jovian Magnetic Field Is Complex, Pioneer 11 Shows
75–50 Two Saturn 1B Fins to Be Replaced
75–51 NASA Resumes Flight Investigation of Air Turbulence
75–52 Sixth Lunar Science Conference Set at Houston
75–53 Zaire to Build First African LANDSAT Ground Station
75–54 Useful Pictures from Space Available
75–55 Black Chrome Coating More Efficient for Solar Collectors
75–56 NASA Future Programs
75–57 All Eight Saturn 1B Fins to Be Replaced
75–58 Mariner Making Last Visit to Small Planet
75–59 Mariner 10 Third Mercury Encounter Press Kit
75–60 Second Commercial Aircraft Begins Pollution Survey
75–61 Effects of Long-Term Space Flight Object of ASTP Medical Experiment
75–62 Crystals to Be Grown in Space During ASTP Mission
75–63 More than 30,000 Persons at Work on Space Shuttle
75–64 Note to Editors: Correction in 75–53
75–65 Aviation Fact Sheet
75–66 Note to Editors: Photos for 75–54
75–67 NASA Signs Agreement to Launch Italian Satellite
75–68 Helios Flies Closest to Sun March 15
75–69 Saturn 1B Fin Replacements Begin
75–70 Note to Editors: Regional Winners Chosen in Viking Student Emblem Contest
75–71 Note to Editors: Capsule History of Weather Satellites
75–72 NASA to Hold Conference for Gas Industry
75–73 First Weather Satellite Launched 15 Years Ago
75–74 Solar Probe Skirmishes Far Side of Sun
75–75 Starlight May Give Club to Freon Threat
75–76 Lunar Samples Now Available for Teaching Purposes
75–77 Apollo Soyuz Simulations Between Moscoe and Houston Begin
75–78 Note to Editors: Apollo Soyuz Briefing April 11 at NASA Headquarters
75–79 Requirements May Ease for Shuttle Non-Pilot Crew Members
75–80 (Cancelled number)
75–81 Solar Energy Bibliography Published
75–82 Rechargeable Heart Pacemaker Has Impressive Reliability Record
75–83 Fabrication of First Shuttle Main Engine Completed
75–84 NASA Tests New Wing for Light Aircraft
75–85 Unique LANDSAT-2 Computer May Have Wide Application
75–86 Federal Aeronautics Research Program 60 Years Old
75–87 (Cancelled number)
75–88 GEOS-C Press Kit
75–89 ASTP Experiment to Probe Ultraviolet Radiation Sources
75–90 Multipurpose Furnace to Be Used for ASTP Experiments

Projected Launch Schedule

(As of April 22, 1975)

SAS–C	May 7	Scout	SM	Third in a series of small astronomy satellites to survey the celestial sphere and search for sources radiating in the X-ray, gamma ray, ultra-violet and other spectral regions both inside and outside our galaxy.
Telesat-C	May 7	Delta	ETR	Third in a series of Canadian Communications satellites to provide television, voice, data and other communications throughout Canada. Reimbursable.
Intelsat IV F1	May 22	A-Centaur	ETR	Continuation of Intelsat series of synchronous satellites providing commercial global telecommunications service to members of the International Telecommunications Satellite Organization. Reimbursable.
Nimbus–F	June 11	Delta	WTR	Experimental meteorological satellite to test instruments for expanding capabilities for remote sensing of the atmosphere.
OSO–I	June	Delta	ETR	Scientific satellite to investigate a variety of specific features of the Sun.
ASTP	July 15	Saturn 1B	ETR	The U.S. launch for the U.S.-Soviet manned space flight. American astronauts in an Apollo Spacecraft will rendezvous and dock with Soviet cosmonauts in an orbiting Russian Soyuz spacecraft to test a new universal docking system and to conduct joint and unilateral experiments.
Marisat–A	July	Delta	ETR	Comsat Corp, satellite to provide maritime satellite communications service. Reimbursable.
Intelsat IVA-A	3rd Qtr	A-Centaur	ETR	First of a series of improved Intelsat satellites that will have almost double the capacity of the present Intelsat IV satellites. Reimbursable.
Symphonie-B	3rd.Qtr.	Delta	ETR	Second joint French/German experimental communications satellite designed for TV, telephone, and data transmission. Reimbursable.
ESRO-COS-B	3rd qtr.	Delta	WTR	European scientific satellite to study extraterrestrial gamma radiation. Reimbursable.
ITOS–E2	July	Delta	WTR	Operational meteorological satellite of the National Weather Service to provide day and night cloud cover imagery. Reimbursable.
Viking-A	3rd Qtr.	TIII-Centaur	ETR	Planetary mission to explore Mars from orbit around the planet with a capsule on its surface.
Viking-B	3rd Qtr.	TIII-Centaur	ETR	Planetary mission to explore Mars from orbit around the planet with a capsule on its surface.
Marisat–B	3rd. Qtr.	Delta	ETR	Second Comsat Corp. satellite to provide maritime satellite communcations services. Reimbursable.
Atmosphere-D	Sept	Delta	WTR	A scientific satellite to investigate the chemical processes and energy transfer mechanisms which control Earth's atmosphere.
Atmosphere-E	Sept.	Delta	ETR	A scientific satellite to investigate the chemical processes and energy transfer mechanisms which control Earth's atmosphere.
SMS–C/GOES–A	Oct.	Delta	ETR	First operational synchronous meteorological satellite of the National Oceanic and Atmospheric Administration of the Department of Commerce to provide continuous day and night global cloud-cover observations. Reimbursable.
Dual Air Density	Nov	Scout	WTR	Two scientific spacecraft will be placed in orbit to obtain simultaneously measurements of the composition of upper and lower levels of the atmosphere.
RCA-A	4th Qtr	Delta	ETR	First of a series of domestic communications satellites for RCA. Reimbursable.
Comstar–A	4th Qtr	A–Centaur	ETR	Domestic communications satellite for Comsat Corp. Reimbursable.
Intelsat IVA-B	4th Qtr.	A-Centaur	ETR	Second of a series of improved Intelsat satellites. Reimbursable.

CAS-C/CTS	4th Qtr	Delta	ETR	Canadian-U.S. cooperative experimental communications satellite to develop and test the technology of high-power satellite television communications systems.
Relativity (Gravity Probe)	1975	Scout	WI	Scientific satellite to make a test of Einstein's Theory of Relativity.
1976				
HELIOS-B	Jan.	TIII-Centaur	ETR	Second West German/NASA cooperative satellite to investigate the properties of the processes in interplanetary space close to the Sun.
RCA-B	1st. Qtr.	Delta	ETR	Second domestic communications satellite for RCA. Reimbursable.
NATO-C	1st Qtr.	Delta	ETR	Communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable.
LAGEOS	1st Qtr.	Delta	WTR	Laser-reflecting satellite to demonstrate relevant space techniques that will contribute to the development and validation of predictive models for earthquake hazard alleviation, ocean-surface conditions and ocean circulation.
Comstar-B	1st Qtr	A-Centaur	ETR	Second Domestic communications satellite for Comsat. Reimbursable.
Intelsat IVA-C	1st Qtr	A-Centaur	ETR	Third of a series of improved Intelsat satellites. Reimbursable.
Westar-C	April	Delta	ETR	Backup domestic communications spacecraft for Western Union. Reimbursable.
ESRO-GEOs	2nd Qtr	Delta	ETR	ESRO spacecraft to support space applications geoscience experiments in ocean topography measurements and solid earth physics. Reimbursable.
Comstar-C	2nd Qtr	A-Centaur	ETR	Third domestic communications satellite for Comsat. Reimbursable.
Marisat-C	1976	Delta	ETR	Comsat Corp. satellite to provide maritime satellite communications services. Reimbursable.

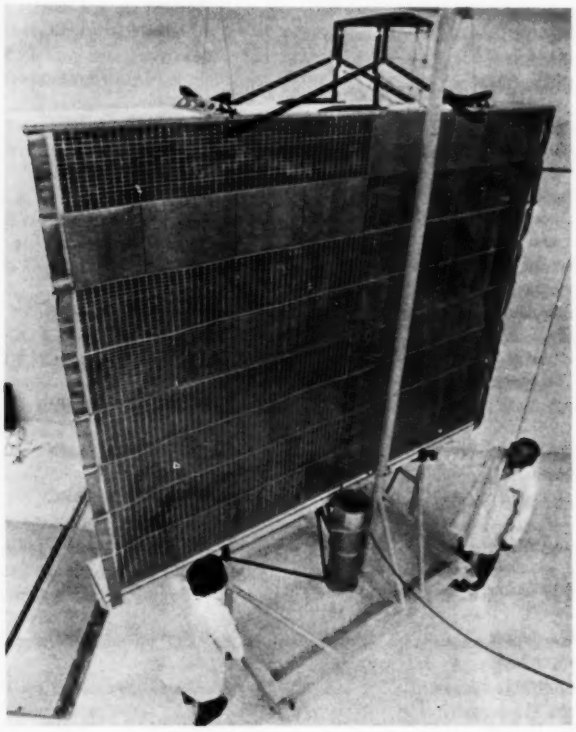
A Better View of Jupiter—This enlarged portion of a picture of Jupiter taken by Pioneer 11 last December from a distance of 600,000 kilometers (373,000 miles) shows for the first time what appear to be hurricane-like storms in the planet's north polar region. It also gives the first detailed view of the breakup of its alternating dark belts and bright zones. Jupiter's polar regions cannot be seen from Earth.

Patents for Inventions Resulting from NASA Research

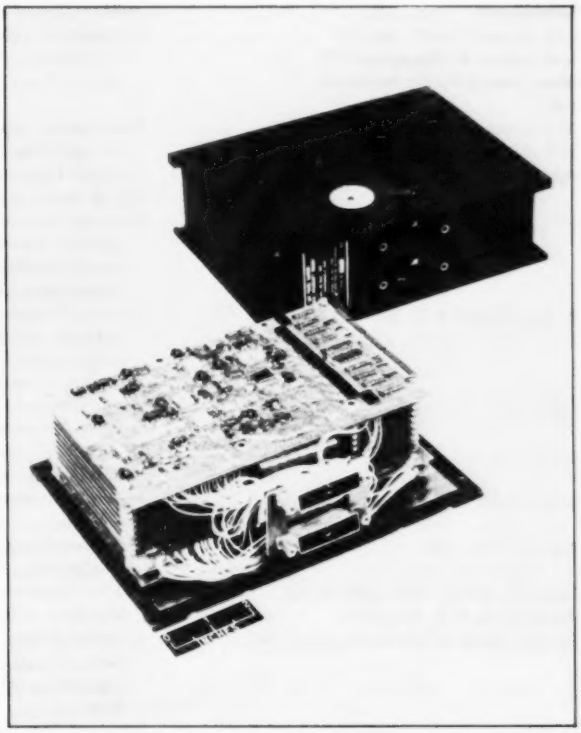
The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel for the indicated installation.

Inventor(s) and Employer	Title and NASA Docket	Patent No.	Installation
Ernest E. Burcher, Daniel J. Jobson, Stephen J. Katzberg and William L. Kelly, IV, NASA/LaRC	Spectrometer Integrated with a Facsimile Camera (LAR-11,207-1)	3,869,212	LaRC
John Osmundson, National Academy of Sciences, and Edward Rowe and Dominick Santarpia, NASA/GSFC	Dually Mode-Locked MD:Yag Laser (GSC-11, 746-1)	3,869,680	GSFC
Maxwell G. Strange, NASA/GSFC	Self-Regulating Proportionally Controlled Heating Apparatus and Technique (GSC-11,752-1)	3,869,597	GSFC
Henry Doong and Mario H. Acuna, NASA/GSFC	Controllable High Voltage Source Having Fast Setting Time (GSC-11,844-1)	3,869,659	GSFC
Ralph F. Kuhn, Jr., Rocketdyne, Canoga Park, CA	Internally Supported Flexible Duct Joint (MFS-19,193-1)	3,869,151	MSFC
Richard B. Hoover, NASA/MSFC, and James H. Underwood, NASA/GSFC	Multiplate Focusing Collimator (MFS-20,932-1)	3,869,615	MSFC
George W. Ulrich, McDonnell Douglas Corp, Huntington Beach, CA	Latching Device (MFS-21,606-1)	3,869,160	MSFC
Anthony E. Siegman, Stanford University, Stanford, CA	Laser System with an Antiresonant Optical Ring (HQN-10,844-1)	3,869,210	NaPO
Raymond B. Trusch and Edward W. O'Connor, Hamilton Standard Div., United Aircraft Corp., Windsor Locks, CT	Condensate Removal Device for Heat Exchangers (MSC-14,143-1)	3,868,830	JSC
Robert W. O'Neill, Lockheed Electronics Co., Inc., Houston, TX	Peak Holding Circuit for Extremely Narrow Pulses (MSC-14,129-1)	3,869,624	JSC
Carl L. Canicatti, NASA/KSC	Voltage Monitoring System (KSC-10,736-1)	3,869,667	KSC
John Dimeff and Dean R. Harrison, NASA/ARC	Diode Quad Transducer and Discriminator Circuit (ARC-10,364-3)	3,869,676	ARC
Allan J. Zuckerwar, Youngstown State Univ., Youngstown, OH	Instrumentation for Measurement of Aircraft Noise and Sonic Boom (LAR-11,173-1)	3,868,856	LaRC
Michael A. Gedwill and Salvatore J. Grisaffe, NASA/LeRC	Duplex Aluminized Coatings (LEW-11,696-2)	3,869,779	LeRC
Vard B. Holland, NASA/ARC	Signal Conditioning Circuit Apparatus (ARC-10,348-1)	3,872,395	ARC
W.D.T. Davies and Stephen C Martin, Bell Aerospace Co., Buffalo, NY	Correlation Type Phase Detector (GSC-11,744-1)	3,875,394	GSFC
Gabriel R. Wallace, NASA/MSFC, William E. Salter, Glenn D. Weathers and Sidney S. Gussow, Sperry-Rand Corp., Huntsville, AL	Pseudo-Noise Test Set for Communication System Evaluation (MFS-22,671-1)	3,875,500	MSFC
Taylor G. Wang, Melvin M. Saffren and Daniel D. Elleman. Caltech/ JPL, Pasadena, CA.	Heat Operated Cryogenic Electrical Generator (NPO-13,303-1)	3,875,435	NaPO
James R. McChesney, Theodore Lerner and Ernest J. Fitch, Bell Aerospace Co., Buffalo, NY	Modulator for Tone and Binary Signals (GSC-11,743-1)	3,878,464	GSFC
George E. Proch, Lockheed Electronics Co., Inc., Houston, TX	Digital Transmitter for Data Bus Communications System (MSC-14,558-1)	3,875,332	JSC
Bernard L. Gordon and James C. Stamps, Taft Broadcasting Crop., Houston, TX	Television Noise Reduction Device (MSC-12,607-1)	3,875,584	JSC
George E. Thornton and Danvis T. Newby, NASA/MSFC	Hole Cutter (MFS-22,649-1)	3,877,833	MSFC
Alan Rembaum, Caltech/JPL, Pasedena, CA	Heat Detection and Compositions and Devices Therefor (NPO-10,764-2)	3,874,240	NaPO
Larry L. Schumacher, Caltech/JPL, Pasadena, CA	Wide Angle Sun Sensor (NPO-13,327-1)	3,875,404	NaPO

Richard J. Salvinski, TRW, Inc., Redondo Beach, CA	Ultrasonically Bonded Valve Assembly (NPO-13,390-1)	3,874,635	NaPO
Lawrence P. Ludwig and William F. Hady, NASA/LeRC	High Speed, Self-Acting Shaft Seal (LEW-11,274-1)	3,874,677	LeRC



Flexible Source of Electricity—This advanced, lightweight, 30-watts-per-pound solar array, beside which stand technicians at the Marshall Space Flight Center, could produce electricity for a variety of uses in space. The 12-foot-wide, 13-foot-long section could be unfolded and folded by remote control, depending on energy requirements and the imminent danger of solar flares. The folding mast supports the array as it spirals out of the can in the middle of the solar-cell panel.



LANDSAT-2 Brain—Here is the NASA-developed, 30-kilogram (14-pound) general purpose digital computer with a 4,096-word memory and a 55-command capability that is serving as the onboard "brain" of the LANDSAT-2 satellite now in orbit. It is the most advanced device of its type ever flown on an unmanned satellite and is part of an agency-wide program conducted by the Low Cost Systems Office to develop standard satellite components and to reduce satellite development costs.

NASA Tech Briefs
The Technology Utilization Office, NASA Headquarters

The following is a listing of published NASA Tech Briefs. Inquiries concerning them should be directed to the TU Office of the originating NASA Center.

Innovator(s)	Title	Number	Center
J.M. Kazaroff, LeRC, and E.D. McClanahan, R. Busch and R.W. Moss, Battelle Pacific Northwest Labs.	Fabrication of Thick Structures by Sputtering	B74-10126	LeRC
M.J. Miller, T.H. Okiishi and G.K. Serovy, Iowa State University	Data Summary and Computer Program for Axial-Flow Pump Rotor Performance	B74-10127	LeRC
Roger J. Trivisonno, LeRC	Computer Program for Calculating Critical Speeds of Rotating Shafts	B74-10128	LeRC
J.A. Albers and J.L. Gregg, LeRC	Computer Program for Calculating Laminar, Transitional, and Turbulent Boundary Layers for a Compressible Axisymmetric Flow	B74-10129	LeRC
T. Katsanis and W.D. McNally, LeRC	Computer Program for Calculating Velocities and Streamlines on Mid-Channel Flow Surface of Axial or Mixed-Flow Turbomachine	B74-10130	LeRC
LeRC	Design Criteria Monograph for Valve Assemblies	B74-10227	LeRC
LeRC	Design Criteria Monograph on Centrifugal Flow Turbopumps	B74-10228	LeRC
John Dimeff, ARC	Improved Nondispersive Infrared Analyzer	B74-10243	ARC
Marnell Smith, ARC	High-Temperature Tensile Tester for Ceramics	B74-10244	ARC
Donald R. Young, ARC, with Gerald Thompson of M.B. Associates	In Vivo Measurement of Mechanical Impedance of Bone	B74-10245	ARC
Louis W. Kunz and David Goorvitch, ARC	Combined Effects of a Converging Beam of Light and Mirror Misalignment in Michelson Interferometry	B74-10246	ARC
C.C. Chamis, R.F. Lark and T.L. Sullivan, LeRC	Advanced Fiber-Composite Hybrids - A New Structural Material	B74-10247	LeRC
D.W. Petrasek and R.A. Signorelli, LeRC	Advanced Tungsten Fiber-Reinforced Nickel Superalloy	B74-10248	LeRC
Lester C. Van Atta and Robert J. Mailloux, Electronic Research Center	Improved Circulary Polarized Antenna	B74-10250	NaPO
Robert J. Mailloux and Paul R. Caron, Electronics Research Center	Phased-Array Antenna Phase Control Circuit Using Frequency Multiplication	B74-10251	NaPO
Alan H. Schoen, Electronics Research Center	Expandable Space Frames	B74-10253	NaPO
Wayne L. Lees, Electronics Research Center	Self-Protected Electrodes Limit Field-Emission Current	B74-10253	NaPO
P.A. Struder, GSFC	Improved Magnetic Suspension Technique	B74-10254	GSFC
C. Curtis Johnson, GSFC, Robert Joseph Martel, Westinghouse Corp., and Fred J. Dietrich and George J. Koloboff, Philco Ford	Amplitude-Steered, Pseudophrased Antenna Array	B74-10255	GSFC
John F. Sutton, GSFC	Synchronized Frequency Transposer	B74-10256	GSFC
Richard Schmidt, GSFC	Bidirectional Zoom Antenna	B74-10257	GSFC
Michael W. Fitzmaurice and Mona Tycz, GSFC	Optical Communication Channel Simulator System	B74-10258	GSFC
Otto Youngbluth, Jr., LaRC	Color-Coded Area Sensitivity Maps of Photomultipliers	B74-10259	LaRC
F.B. Beck, LaRC, and C.A. Mentzer and L. Peters, Jr., Ohio University	Horn Antenna with V-Shaped Corrugated Surface	B74-10260	LaRC
William E. Zorumski, LaRC	Noise Suppressor	B74-10261	LaRC

Jerry W. Moody, Roger W. Shaw and Robert W. Sandfort, Monsanto Research Corp.	Depositing Spacing Layers on Magnetic Film with Liquid Phase Epitaxy	B74-10262	LaRC
C.A. Hardesty, LaRC, and A.D. Brooks and R.P. Donovan, Research Triangle Institute	Low-Temperature Electrostatic Silicon-to-Silicon Seals Using Sputtered Borosillicate Glass	B74-10263	LaRC
T.U. Marston and A.G. Atkins, University of Michigan	Controlled Intermittent Interfacial Bond Concept for Composite Materials	B74-10264	LaRC
T.G. McNamara, Rockwell International Corp.	High-Strength Alloy with Resistance to Hydrogen-Environment Embrittlement	B74-10265	MSFC
K.G. Anthony and E.P. Herdon, MSFC	Self-Regenerating Dessicant System	B74-10266	MSFC
W.J. Britz, W.A. Boshers and J.J. Kaufmann, MSFC	Lead-Oxygen Closed-Loop Battery System	B74-10267	MSFC
J.L. Bradspies, S.B. Brummer, G.L. Holleck and L.L. Nelsen, Tyco Laboratories, Inc.	Carbon Monoxide Detector	B74-10268	MSFC
W.C. Schneider, JSC	New Insulation Attachment Method Eliminates Compatibility Bondline Stresses	B74-10269	JSC
J.A. Kinzler, LG. Fehrenkamp, J.T. Heffernam and W.S. Lee, JSC	Plastic Covering on Airfoil Structure Provides Smooth Uninterrupted surface	B74-10270	JSC
J.S. Ogle, Lockheed Missiles & Space Co.	Volume Measuring System	B74-10271	JSC
M.E. Wakefield, Martin Marietta Corp.	Explosive Welding Technique for Joining Aluminum and Steel Tubes	B74-10272	JSC
M.M. Gilman, Rockwell International Corp.	Flange Design for Large-Scale Modular Assembly Jigs	B74-10273	JSC
Jack K. Holmes, Christopher Carl and Carl R. Tagnelia, Caltech/JPL	Digital Second-Order Phased-Locked Loop	B74-10274	NaPO
Kenneth C. Schmidt, Bendix Corp.	Improved Channel Multiplier for Radiation-and-Particle Detectors	B74-10275	NaPO
Heinz G. Boettger and Jehuda Yinon, Caltech/JPL	Negative Ion Spectrometry for Detecting Nitrated Explosives	B74-10276	NaPO
Louis R. Toth and Ray Hagler, Jr., Caltech/JPL	Full-Flow Fluid Filter	B74-10277	NaPO
Vilhelm J. Jahnsen and Charles F. Campen, Jr., Caltech/JPL	Liquid Sample Processor	B74-10278	NaPO
George C. Gilley, Caltech/JPL	Automated Maintenance for Complex Hybrid Systems	B74-10279	NaPO
W. Richard Scott, Caltech/JPL	Reliability Data for Electronic and Electromechanical Components: A Report	B74-10280	NaPO
Ronald A. Marzek and William S. Read, Caltech/JPL	Straight-Line IC Removal Tool	B74-10281	NaPO
Theodore J. Ebersole and Robert E. Andrews, General Electric Co.	DC-to-AC Inverter Ratio Failure Detector	B74-10282	NaPO
Richard T. Woo and Arthur Ludwig, NASA Pasadena Office	Low-loss, Circularly-Polarized Dichroic Plate	B74-10283	NaPO
Robert E. Edelson, John R. Gilder, Glenn W. Garrison, Anthony J. Spear, Paul M. Kotani, Bruce D. Trumpis, Barry K. Levitt, Cheryl E. Hanna and Bernard Dorsch, Caltech/JPL	Telecommunications Systems Design Techniques Handbook	B74-10284	NaPO
A.N. Ashurst, M. Goldstein and M.J. Ryan, Battelle Memorial Institute; and G.G. Lessmann and W.A. Bryant, Westinghouse Astronuclear Lab.	Fabrication of Complex Structures or Assemblies by Hot Isostatic Pressure (HIP) Welding	B74-10124	LeRC

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A Cooperative Program to Make Helicopters Safer

NASA has teamed up with the U.S. Army to conduct crashworthiness tests for the purpose of supplying aircraft designers with important structural information before they go to the drawing boards. It is all part of a program to find out what happens to aircraft and their passengers and cargo when they crash.

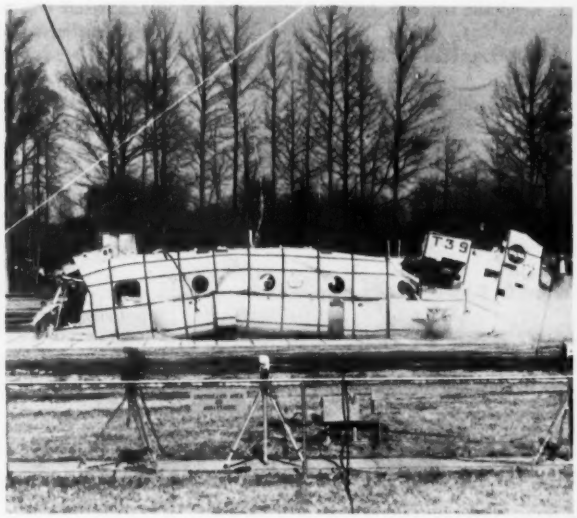
At Langley Research Center recently, a 22,448-pound Army CH-47 helicopter that had been damaged by fire at the plant where it was manufactured was dropped on a cement surface from a height of 51 feet. It was the 39th in a series of test crashes conducted by the Army over the last 16 years, but the first in which NASA had a part.

Two umbilical cables for transmitting data on every aspect of the crash, from acceleration to overall deformation, extended from the helicopter's windows, one electronically connected to the control tower and the other linked to a military instrumentation van.

The CH-47 was outfitted with a variety of different seats, ranging from those already in production to prototypes for crashworthy models. Occupying them were anthropomorphic dummies designed to estimate the impact of the crash upon human bodies. Also crowded into the helicopter were lights and seven high-speed, chock-mounted cameras to record the effect upon the interior of the aircraft.

It took only a second for the helicopter to plunge to the ground, where it crumpled. Representatives from the Federal Aviation Administration, National Transportation Safety Board, and Office of Naval Reserve, as well as other military officials, were on hand to examine the wreck.

Information from the crash, totaling 129 channels of data, will be used in an effort to design aircraft which will offer passengers and cargo the best chances of surviving a crash.



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